Investigating The Potential Of Terrestrial Laser Scanner For Volume Calculation

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Key words: laser scanning, terrestrial laser scan, digital terrain model, volume calculation.

SUMMARY

In this paper, we investigate the potential of terrestrial laser scanner for volume calculation in comparison with total station. For this purpose, we conduct volume calculation of test area by using terrestrial laser scanner and total station. For each technology, the volume calculation methodology is constituted of the following steps: data acquisition planning, data acquisition execution, data analysis, DEM creation and volume calculation. The comparison of the results of the two technologies is performed as regards to the accuracy, time and cost aspects. Riegl VZ – 400 laser scanner and Leica TS02 total station are used for the data acquisition. The results have shown that the laser scanning technology allows precise volume calculation. In comparison with total station, the 3D data acquisition is rapid and automatic and allows more various possibilities of data representation. Nevertheless, the analysis of point clouds is complex and time consuming and require very expert human operators.

1. Introduction

Over the last years, the terrestrial laser scanning technology become more familiar and constitutes an alternative solution to classical surveying methods. The volume calculation is one of the applications which require precise data acquisition. In this paper, we are concerned by the investigation of the potential of the terrestrial laser scanning technology for volume calculation. This investigation is done in comparison with the use of total station. The study area is rural zone with moderate topography. The methodology is described by the figure 1. Four important steps can be identified: planning step, data acquisition, data analysis and volume calculation.

2. Methodology

2.1 Planning step

In this step, we inspect the study area in order to determine: the number of the stations to scan the holly area, the optimal location of the targets helpful to combine the different point clouds acquired from different stations. We determine also the angular resolution that allows the acquisition of point clouds with the desired density (1 point each 25 cm).

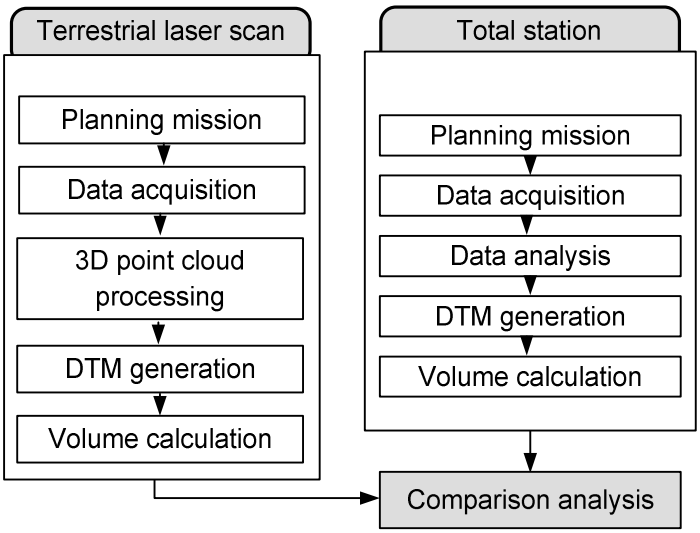

Figure 1. Adopted methodology

2.2 Data acquisition

Riegl VZ – 400 laser scanner and Leica TS02 total station are used for the data acquisition. The data acquisition with the laser scan is assisted by the integrated software. So, we can pre-visualize acquired data in order to determine the adequate parameters. After the scanning

operation, we do automatic target detection in point clouds. The coordinates of the targets are determined by total station.

2.3 Data processing

The processing of the collected point clouds is realized through three steps: geo-referencing, cleaning and resampling. In the first step, the different point clouds collected from different stations are combined based on the common targets. Then, the cleaning operation consists to eliminate undesirable data and preserve only interested points. We conduct this task manually. In the resampling operation, we reduce the data volume in respect to the desired density of points.

2.4 Volume calculation

The principle of volume calculation of RiScan Pro software is as follows: the surface is divided into cells. For each cell, the volume of the corresponding cuboid is calculated with regard to a reference plan. The final volume is the addition of each cuboid volume.

3. Comparative analysis

Volume calculation:
The difference between the volumes determined by the two methods is about 1 %. This value can be considered important in relation to the cost of the terrain soil. The high density of the laserscan data can represent with more fidelity the studied terrain and so, the volume estimated by this technique can be more exact.

Data acquisition:
With regard to time, the data acquisition by laser scan was 9 times faster than by total station (4 hours by laser-scan and in 35 h by total station). Also, the total station requires at least two human operators. With the laser-scanning can be done by one human operator.
The use of the associated software during the laser scanning operation minimizes the necessary time for data acquisition and allows the inspection of the data in real time. So, we can verify the result before changing the station point.

Data analysis:
The analysis of the total station collected data can be done in CAD software. The analysis of laserscan data requires specialized software and expert human operator. To handle the large amount of collected data by the laserscan, it is necessary to have powerful computer.
The analysis of the laserscan data takes more time, specially the cleaning step which it is still conducted manually. The quality of the cleaning operation influences on the quality of the generated DTM and its fidelity to represent the studied terrain.

Derived products:
Each of the two technologies allows a generation of several of products like DTM, contour lines, profiles… Nevertheless, the high density of the collected laser point clouds offers the

possibility of data resampling according to different densities in relation with the desired product scale.

4. Conclusion

We have presented the methodology used for investigate on the potential of terrestrial laserscan for volume calculation in comparison to the use of total station. The comparative analysis has shown that the laser scanning technology allows precise volume calculation. In comparison with total station, the 3D data acquisition is rapid and automatic and allows more various possibilities of data representation. Nevertheless, the analysis of point clouds is complex and time consuming and require very expert human operators.

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